

REMARKS

In view of the foregoing amendments and the following remarks, reconsideration is respectfully requested.

Applicant has endeavored to respond to each of the issues raised by the Examiner so as to advance the prosecution of the application to allowance.

Applicant has amended claims 1, 4 and 5 and has cancelled claims 2 and 3. The claims are fully supported in the specification as originally filed.

It is respectfully submitted that the claims, as amended, serve to overcome the rejection of claims 1-6 under 35 U.S.C. § 103(a) as being unpatentable over Szczesniewski et al. (U.S. 6,358,870 B1) in view of Bair (U.S. 2,220,750). This rejection is traversed.

The invention as set forth in amended claim 1 recites a method for preparing a pre-reacted and carbon dioxide-free synthetic compound for the production of glass formulas, comprising: preparing pre-reacted and carbon dioxide free synthetic compounds for the production of glass formulas, comprising mixing raw materials, minerals, partially treated minerals, intermediate products thereof, containing molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium, and mixtures thereof, **in stoichiometric amounts corresponding to one or more selected invariant points or points on a line connecting invariant points on a phase diagram;**

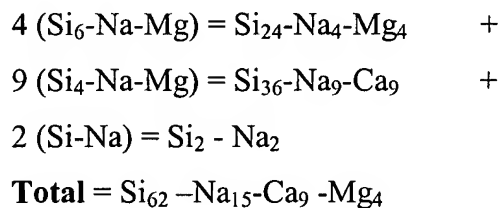
adding cullet between 5 to 25% by weight to the batch of raw materials, which contains the molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium and mixtures, in selected stoichiometric amounts in order to increase the velocity of the calcinations process, the decarbonization grade of the batch and the formation of the desired crystalline structures; and

calcining the mixture at reaction temperatures which do not form a liquid phase and having CO₂ release temperature which are below the melting or dissociating temperatures of the synthetic compound.

As the Examiner has commented, adding cullet in a known process of melting

glass would be obvious to those of ordinary skill in the art. **However, this is not the case.** For example, to obtain the advantages described of the claimed invention, it is necessary that the cullet be added or mixed with minerals, partially treated minerals or intermediate products therefrom, containing molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium and mixtures thereof, **in selected stoichiometric amounts, which were selected from one or invariant points or from points on a line connecting invariant points of a phase diagram, which is prepared before a calcination step and before melting.**

These invariant points can, for example, be selected from three (3) different invariant points of the K.A. Shahid & F.P. Glasser phase diagram, by means of which it is possible to totally saturate all of the sodium, calcium and magnesium necessary for said glass formulation. For example, by using the following three invariant points from the phase diagram of K.A. Shahid & F.P. Glasser, namely, Si₆-Na-Mg, Si₄-Na-Mg and Si-Na, we have:



Thus, in the above-referenced glass formula, the sodium, calcium and magnesium were fully saturated, and only silica must be added to reach the necessary silica content. The phase diagram of K.A. Shahid & F.P. Glasser, as referenced at page 3 of the specification, follows:

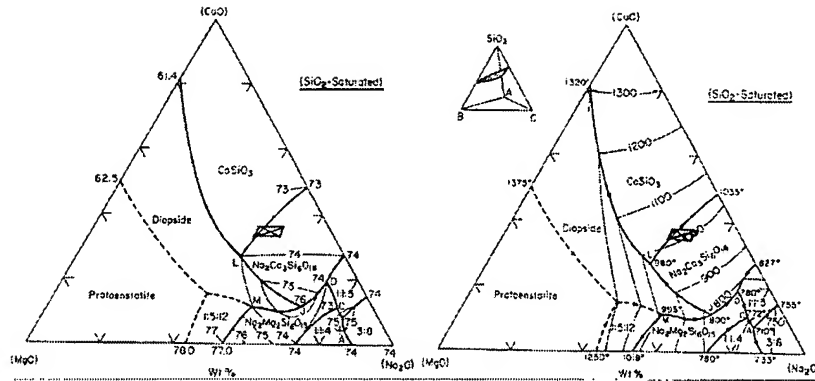


Figure 1. Map of Tridymite Liquidus Surface in $\text{Na}_2\text{O}-\text{CaO}-\text{MgO}-\text{SiO}_2$ System; Shahid and Glasser (1972), reproduced in Roth et al. (1981)

Other examples are illustrated on the phase diagram of Morey & Bowen.

- a) $\text{Na}_2\text{O} \cdot 0.2\text{CaO} \cdot 3\text{SiO}_2$
- b) $\text{Na}_2\text{O} \cdot 0.3\text{CaO} \cdot 6\text{SiO}_2$
- c) $2\text{Na}_2\text{O} \cdot \text{CaO} \cdot 3\text{SiO}_2$

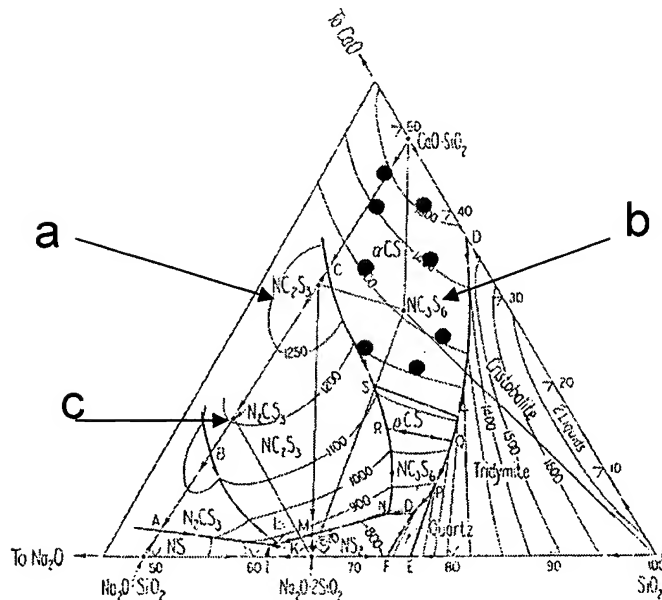


FIG. 2. Phase diagram for the $\text{CaO}-\text{Na}_2\text{O}-\text{SiO}_2$ ternary oxide system. Black circles indicate the compositions of the ABCNS-4-XX glasses. Reprinted with permission of the American Ceramic Society, www.ceramics.org. Copyright 1964. All rights reserved.²⁰

The advantages obtained in the formulation with the addition of cullet, are only obtained with the molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium and

mixtures thereof, in selected stoichiometric amounts, which were selected from one or invariant points, or from points on a line connecting invariant points of the phase diagram of K.A. Shahid & F.P. Glasser, namely, $\text{Si}_6\text{-Na-Mg}$, $\text{Si}_4\text{-Na-Mg}$ and Si-Na , or the phase diagram of Morey & Bowen.

Applicant has found that, if cullet is added to the formulation in bulk form or forming binders, the following advantages were unexpectedly and surprisingly realized:

1. The velocity of the calcination process is surprisingly increased.
2. The decarbonization grade of the mixture is increased two-fold, when compared to when cullet is not used.
3. A significant impact in the formation of the desirable crystalline structures is achieved, since its use results in the formation of, in large measure, calcium and sodium silicate ($\text{Na}_2\text{CaSi}_3\text{O}_9$).

Applicant has achieved the objective of his invention, namely, to provide a method for preparing pre-reacted batches of raw materials for the production of glass formulas, which comprises **the addition of cullet, before being subjected to calcination, to stoichiometric amounts of substances containing molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium and mixtures thereof** having reaction temperatures which do not form a liquid phase, and which are selected from invariant points or from points on a line connecting invariant points of phase diagrams of said molecular systems, to complete or approach a desired molecular glass formula.

To confirm the effects of adding cullet to the mixture of raw materials for preparing the pre-reacted batches, three experimental procedures for forming briquettes of raw materials were carried out. The results set forth at Table 1 (at page 10 of the specification), show the surprisingly beneficial effects that the cullet has in increasing the velocity of the calcination process, as well as in the decarbonization grade of the mixture (with a content of between 1 and 0.5% of CO_2 remaining) since it permits penetration within the briquette, which is a mixture of raw materials, that is absorbed toward the center of the briquettes, resulting in a much more complete reaction of the components of the mixture. Furthermore, in experiments 8 and 9, the levels of carbon dioxide were maintained 1% per below of the limit.

As Applicant has previously demonstrated, the method of the present invention provides unexpected technical benefits, which would not have been obvious to those of ordinary skill in the art. To obtain the unexpected results realized by Applicant, it is necessary to add or mix cullet with minerals, partially treated minerals or intermediate products therefrom, containing molecular systems of silica-sodium, silica-sodium-calcium, silica-sodium-magnesium, silica-calcium-magnesium, silica-sodium-calcium-magnesium and mixtures thereof, **in selected stoichiometric amounts, which are selected from one or invariant points or from points on a line connecting invariant points of a phase diagram, which is prepared before a calcination step and before melting.** The unexpected results obtained with the present invention cannot be obtained by the conventional technical means commonly employed by those skilled in the art to adjust the conditions for the calcining and the melting of glass.

Regarding the secondary reference employed by the Examiner, Bair (U.S. Patent No. 2,220,750) discloses a typical process for making glass and the advantages provided by the use of cullet, as well as the advantages of utilizing waste fine sand and milled glass obtained from the grinding and polishing process required for obtaining a uniform body of glass. Furthermore, in Bair's three (3) examples, he mixes the waste sand with fluxes of calcium and sodium in the required proportions to make a *known glass formula*, and then agglomerates or prepares nodules from the resulting mass. This gives him the advantages of avoiding any loss by dusting, and in reducing the time required for melting the glass down because each nodule is of exactly the same composition as the others and upon melting they flow together to form a homogeneous body.

However, in all of the cases discussed by Bair, he is disclosing a complete glass formula and his agglomerated mass or nodules have a eutectic temperature that produce a solid-liquid reaction that requires complete melting of the nodules at elevated temperatures in order to extract the CO₂ contained in the fluxes used. This also implies that in the pot or glass tank there has to be a refining stage in order to eliminate the entrapped CO₂ bubbles. Thus, even though there is a saving in the time required for melting and the melted glass is more uniform, the Bair reference has *absolutely* nothing to do with the process disclosed in the Szczesniewski '870 patent reference, whereby a nodule of a special combination of sand and fluxes that *do not add up to a known glass*

formula is used to create a pre-reacted and pre-degasified sodium, calcium silicate by a solid-solid reaction at low temperatures.

This is something that could never be done with a combination of sand and fluxes that add up to the formula of a known glass, and thus cannot logically or properly be combined with Bair's disclosure, which relates to the conventional and very well-known process of producing glass. There is no motivation or suggestion in the references that they should be combined. It is only the instant specification which provides the motivation to combine. The Examiner is not permitted to fashion an obviousness rejection from that which Applicant discloses in his own specification. ***The suggestion or motivation to combine must be found in the art.***

The claims herein are based on an entirely different mechanism that Applicant has found occurs due to the presence of glass cullet when pre-reacted and pre-degasified nodules are formed with the formulas selected from the invariant points used by Szczesniewski in the Si-Ca-Na phase diagrams. In this case, Szczesniewski found that these combinations would form special sodium, calcium silicates at low temperatures by means of a solid-solid reaction between the material components, and that degasification to levels of between 1 and 0.5% by weight would be attained after 25 minutes of treatment.

In studying the degasification process, Applicant noted that it starts from the outside core of the nodules, and then it progresses towards their interior. Thus, heat is gradually conducted to the interior of the nodule as pores are created in the outer crust and the surrounding gases are allowed to flow in. What Applicant unexpectedly found was that when glass cullet was added to the nodules, it served as an added vehicle for conducting heat directly to the center of the nodules, and that this mechanism produced a quicker degasification time than the twenty-five (25) minutes that had been reported previously. This certainly saves time and energy, but in the claimed invention the presence of glass cullet (which by the way is not milled to a fine powder) performs a totally different function than the role it plays when one adds glass cullet to a complete glass formula that is being melted in a glass tank.

If one were to replace 10 or 20 % of a glass formula by glass cullet in a glass tank, one would certainly be seeking energy savings, due to the fact that the melting

temperature of the cycled glass is lower than that which would have been expended if the original 100% of raw materials had been used. However, this is something which is totally different from, and cannot be compared with, the role that the glass cullet performs in enhancing a solid-solid reaction within a special sodium, calcium silicate that is *not* the final glass formula that will be used in a glass melting tank.

In conclusion, the claimed method for preparing pre-reacted synthetic batches is unobvious over the combination of references employed by the Examiner. Since the claimed process employs an unobvious sequence of steps, which is neither taught nor suggested by the combination of art, it distinguishes thereover. The § 103(a) rejection has accordingly been overcome and its withdrawal is solicited.

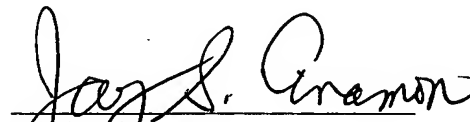
In view of the above, it is believed that the claims are in condition for allowance, and a Notice to that effect is solicited.

Please charge any fees which may be due to our Deposit Account No. 01-0035.

Respectfully submitted,

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